



**MATHEMATICAL INSTITUTE**  
ANDREW WILES BUILDING

## Job Description and Selection Criteria

<b>Job title</b>	Postdoctoral Research Associate in Machine Learning and Computational Fluid Dynamics
<b>Division</b>	Mathematical, Physical and Life Sciences
<b>Department</b>	Mathematical Institute
<b>Location</b>	Andrew Wiles Building, Radcliffe Observatory Quarter, Woodstock Road, Oxford, OX2 6GG.
<b>Grade and salary</b>	Grade 7: £36,386- £42,155 per annum
<b>Hours</b>	Full time
<b>Contract type</b>	Fixed-term (36 months)
<b>Reporting to</b>	Professor Justin Sirignano
<b>Vacancy reference</b>	161020
<b>Additional information</b>	<p>This is a full-time position that cannot be held concurrently with any other substantive post without the explicit permission of the Head of Department.</p> <p>This post is subject to a 12-month probationary period.</p> <p>This post is funded by an Engineering and Physical Sciences Research Council research grant which ends on 30<sup>th</sup> March 2026. We therefore anticipate a starting date of 1<sup>st</sup> April 2023 or as soon as possible thereafter.</p> <p><b>(PLEASE NOTE: Applicants are responsible for contacting their referees and making sure that their letters are received by the closing date)</b></p>
<b>Research topic</b>	Deep Learning Closure Models for Large-Eddy Simulation of Unsteady Aerodynamics
<b>Principal Investigator / supervisor</b>	Prof. Jonathan MacArt and Prof. Justin Sirignano



<b>Project team</b>	Prof. Jonathan MacArt and Prof. Justin Sirignano
<b>Project web site</b>	<a href="https://sites.nd.edu/macart-group/">https://sites.nd.edu/macart-group/</a> <a href="https://www.maths.ox.ac.uk/people/justin.sirignano">https://www.maths.ox.ac.uk/people/justin.sirignano</a>
<b>Funding partner</b>	This research project is funded by a joint NSF-EPSRC grant to the University of Notre Dame and the University of Oxford. The postdoctoral position at the University of Oxford is funded by EPSRC.
<b>Recent publications</b>	<ol style="list-style-type: none"> <li>1. "Deep Learning Closure Models for Large-Eddy Simulation of Flows around Bluff Bodies." J. Sirignano and J.F. MacArt. <a href="https://arxiv.org/abs/2208.03498">https://arxiv.org/abs/2208.03498</a>, 2022.</li> <li>2. "Deep Learning Closure of the Navier-Stokes Equations for Transitional Flows." J. F. MacArt, J. Sirignano, and M. Panesi. Proceedings of AIAA Scitech, 2022.</li> <li>3. "Embedded training of neural-network subgrid-scale turbulence models." J. F. MacArt, J. Sirignano, and J. B. Freund. Physical Review Fluids, 2021.</li> <li>4. "DPM: A deep learning PDE augmentation method with application to large-eddy simulation." J. Sirignano, J. F. MacArt, and J. B. Freund. Journal of Computational Physics, 2020.</li> </ol>

## The role

We invite applications for a Postdoctoral Research Associate to join the Mathematical Institute at the University of Oxford to conduct research on the topic of deep learning closure models for large-eddy simulation (LES) of unsteady aerodynamics. This is a fixed-term position for up to 36 months. The successful candidate will join the Data Science research group at the Mathematical Institute and carry out research in an area related to the project.

This research project is funded by a joint NSF-EPSRC grant to the University of Oxford and the University of Notre Dame. The research will involve collaboration between the postdoctoral research associate, Prof. Jonathan MacArt (University of Notre Dame), and Prof. Justin Sirignano (University of Oxford). We anticipate a starting date of 1st April 2023 (or as soon as possible thereafter) and an expected end date of 30th March 2026. There may be scope for flexibility in the start and end dates of this position, subject to approval by the department and the funding agencies.

Accurate prediction of unsteady turbulent flows is crucial for the design of lighter, more efficient, and higher-performance flight vehicles. Fully resolved numerical solutions of the Navier-Stokes equations at flight-relevant Reynolds numbers are typically computationally intractable; thus, flight vehicle design relies on approximations including the LES equations solved on coarse meshes and the time- and/or space-averaged Reynolds-averaged Navier-Stokes (RANS) equations. However, these approximations to the fully-resolved Navier-Stokes equations are often inaccurate due to the closure models and coarse grid resolutions required to attain acceptable computational cost.

This project will develop and evaluate deep learning large-eddy simulation (DL-LES) models for turbulent separated flow in external-aerodynamics configurations. The objective is to use deep learning closure models to improve the predictive accuracy of LES for aerodynamic configurations relevant to real-world applications. Particular focus will be given to hybrid RANS–

LES formalisms for accurate near-wall predictions and the development of embedded multi-fidelity data assimilation methods.

The research is highly interdisciplinary, merging computational fluid dynamics (CFD), machine learning, optimisation, and high-performance computing (HPC). The successful applicant will have a strong background in CFD, partial differential equations, and HPC, as well as a willingness to learn new methods and programming paradigms. Responsibilities of the role include contributing to the formulation, implementation, and testing of the project's methods and models, presenting work at domestic and international conferences, as well as authoring and co-authoring journal articles.

## **Responsibilities**

The successful candidate will be expected to:

- Manage own academic research and administrative activities. This involves small scale project management, to coordinate multiple aspects of work to meet deadlines;
- Adapt existing and develop new research methodologies;
- Prepare working theories and analyse qualitative and/or quantitative data from a variety of sources, reviewing and refining theories as appropriate;
- Contribute ideas for new research projects;
- Develop ideas for generating research income, and present detailed research proposals to senior researchers;
- Collaborate in the preparation of research publications;
- Present papers at conferences;
- Act as a source of information and advice to other members of the group on methodologies or procedures;
- Develop, implement, and evaluate LES models using HPC.

It is the policy of the Mathematical Institute to give all PDRAs the opportunity to teach, where the conditions of the grant allow this, and to require teaching if there is a departmental need. Such teaching, if undertaken, will not exceed 3 hours per week for 24 weeks of the year and additional remuneration will be paid. It will normally be delivered as classes, but it might also involve giving lectures or college tutorials.

## Selection criteria

Your application will be judged only against the criteria which are set out below. You should ensure that your application shows clearly how your skills and experience meet these criteria.

The Selection Committee for this process is expected to comprise;

- Professor Justin Sirignano (Chair, Mathematical Institute)
- Professor Jonathan MacArt (University of Notre Dame)
- Third panel member to be confirmed

The University is committed to fairness, consistency and transparency in selection decisions. Members of the selection committee are aware of the principles of equality of opportunity, fair selection and the risks of bias.

If, for any reason, you have taken a career break, parental leave or have had an atypical career and wish to disclose this in your application, the selection committee will take this into account, recognising that the quantity of your experience may be reduced as a result

### Essential selection criteria

The successful candidate will be expected to meet the following criteria:

- have, or be close to completing, a PhD in mathematics, aerospace engineering, mechanical engineering, or a related discipline;
- Possess sufficient specialist knowledge in the discipline to work within established research programmes, including experience in **all of** the below areas:
  - Computational fluid dynamics
  - Large-eddy simulation
  - Partial differential equations
  - High-performance computing
- Previous experience of contributing to publications and presentations;
- Excellent communication skills, including the ability to write for publication, present research proposals and results, and represent the research group at meetings.

### Desirable selection criteria

- Experience of independently managing a discrete area of a research project
- Experience of actively collaborating in the development of research articles for publication

## Pre-employment screening

### Standard checks

If you are offered the post, the offer will be subject to standard pre-employment checks. You will be asked to provide: proof of your right-to-work in the UK; proof of your identity; and (if we haven't done so already) we will contact the referees you have nominated. You will also be asked to complete a health declaration so that you can tell us about any health conditions or disabilities for which you may need us to make appropriate adjustments.

Please read the candidate notes on the University's pre-employment screening procedures at: <https://www.jobs.ox.ac.uk/pre-employment-checks>

## About the University of Oxford

Welcome to the University of Oxford. We aim to lead the world in research and education for the benefit of society both in the UK and globally. Oxford's researchers engage with academic, commercial and cultural partners across the world to stimulate high-quality research and enable innovation through a broad range of social, policy and economic impacts.

We believe our strengths lie both in empowering individuals and teams to address fundamental questions of global significance, while providing all our staff with a welcoming and inclusive workplace that enables everyone to develop and do their best work. Recognising that diversity is our strength, vital for innovation and creativity, we aspire to build a truly diverse community which values and respects every individual's unique contribution.

While we have long traditions of scholarship, we are also forward-looking, creative and cutting-edge. Oxford is one of Europe's most entrepreneurial universities and we rank first in the UK for university spin-outs, and in recent years we have spun out 15-20 new companies every year. We are also recognised as leaders in support for social enterprise.

Join us and you will find a unique, democratic and international community, a great range of staff benefits and access to a vibrant array of cultural activities in the beautiful city of Oxford.

For more information, please visit [www.ox.ac.uk/about/organisation](http://www.ox.ac.uk/about/organisation).

## The Mathematical Institute

The Mathematical Institute, as Oxford's Department of Mathematics is known, is one of the leading mathematics departments in the world. Our mathematical research, impact and environment have twice been ranked first in the UK, in the 2021 and 2014 Research Excellence Framework exercises, a government review of research in all UK universities. The Mathematical Institute is the focus of research into both fundamental mathematics and its applications, and our inclusive nature and overall size are key factors in the provision of an outstanding research environment for our members. The large number of faculty, postdocs and students in the Mathematical Institute, all supported by excellent facilities, allows us to maintain a critical mass in research groups encompassing a wide spectrum of mathematics, while our integrated nature fosters collaboration between fields. We also host a large number of academic visitors. Our web pages ([www.maths.ox.ac.uk](http://www.maths.ox.ac.uk)) provide comprehensive information about all of our activities.

The research activities of the Institute as a whole can be gauged from the web pages of the research groups and centres within the Institute ([www.maths.ox.ac.uk/research](http://www.maths.ox.ac.uk/research)). The range of our research interests is well reflected by the profile of our faculty as listed at [www.maths.ox.ac.uk/people](http://www.maths.ox.ac.uk/people). Many members of the Institute have received prestigious prizes and other special recognition for their work; some recent examples can be found at [www.maths.ox.ac.uk/news](http://www.maths.ox.ac.uk/news).

The Mathematical Institute moved into the purpose-built Andrew Wiles Building in the University's Radcliffe Observatory Quarter in September 2013. As well as providing offices for all staff and graduate students, it houses a range of other facilities available to members of the department, including the Whitehead Library, a large range of meeting rooms, teaching spaces, lecture rooms, and social spaces, and a small laboratory for carrying out table-top experiments. For more information, see [www.maths.ox.ac.uk/about-us](http://www.maths.ox.ac.uk/about-us).

Teaching is central to the life of the Mathematical Institute and we have around 900 undergraduates on course, some on joint courses with other departments. We teach around 250 students each year across five taught master's degree courses, and have over 250

doctoral students in residence at any one time. Our doctoral programme always attracts the best research students from across the world, and we have a broad mentoring and training programme.

The Mathematical Institute strives to ensure that all staff and students are given the opportunities and support they need to achieve their potential. We are committed to equality of opportunities and to advancing women's careers. We support staff returning from long-term absence with teaching relief, offer flexible working arrangements, and the department sponsors University nursery places to support the priority allocation of childcare to our staff. Further information about family support can be found below under University Benefits, Terms and Conditions. Our [Equality, Diversity & Inclusion Committee](#)<sup>1</sup> contributes to many aspects of our work.

As part of the department's commitment to openness, inclusivity and transparency, we strongly encourage applications from all who consider they meet the requirements of the post, and particularly from women and ethnic minorities.

We have a number of family-friendly policies, such as the right to apply for flexible working, hybrid working, and support for staff returning from periods of extended absence. We are committed to ensuring an inclusive interview process and will reimburse up to £250 towards any additional care costs (for a dependent child or adult) incurred as a result of attending an interview for this position, which may not be applicable if the interviews are held remotely.

For more information on the Mathematical Institute, please visit: [www.maths.ox.ac.uk](http://www.maths.ox.ac.uk)

The Mathematical Institute holds a silver Athena Swan award to recognise advancement of gender equality: representation, progression and success for all.

## **The Mathematical, Physical, and Life Sciences Division**

The Mathematical, Physical, and Life Sciences (MPLS) Division is one of the four academic divisions of the University. In the results of the six-yearly UK-wide assessment of university research, REF2014, the MPLS division received the highest overall grade point average (GPA) and the highest GPA for outputs. We received the highest proportion of 4\* outputs, and the highest proportion of 4\* activity overall. More than 50 per cent of MPLS activity was assessed as world leading.

The MPLS Division's 10 departments and 3 interdisciplinary units span the full spectrum of the mathematical, computational, physical, engineering and life sciences, and undertake both fundamental research and cutting-edge applied work. Our research addresses major societal and technological challenges and is increasingly focused on key interdisciplinary issues. MPLS is proud to be the home of some of the most creative and innovative scientific thinkers and leaders working in academe. We have a strong tradition of attracting and nurturing the very best early career researchers who regularly secure prestigious fellowships.

We have around 6,000 students and play a major role in training the next generation of leading scientists. Oxford's international reputation for excellence in teaching is reflected in its position at the top of the major league tables and subject assessments.

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<sup>1</sup> The Mathematical Institute was a founding supporter of the London Mathematical Society's Good Practice Scheme ([www.lms.ac.uk/women/good-practice-scheme](http://www.lms.ac.uk/women/good-practice-scheme)). We have held an Athena SWAN Silver Award since 2016.

MPLS is dedicated to bringing the wonder and potential of science to the attention of audiences far beyond the world of academia. We have a strong commitment to supporting public engagement in science through initiatives including the Oxford Sparks portal (<http://www.oxfordsparks.net/>) and a large variety of outreach activities. We also endeavour to bring the potential of our scientific efforts forward for practical and beneficial application to the real world and our desire is to link our best scientific minds with industry and public policy makers.

For more information about the MPLS division, please visit: <http://www.mpls.ox.ac.uk/>

## How to Apply

Applications are made through our e-recruitment system and you will find all the information you need about how to apply on our Jobs website <https://www.jobs.ox.ac.uk/how-to-apply>.

Your application will be judged solely on the basis of how you demonstrate that you meet the selection criteria stated in the job description.

As part of your application you will be asked to provide details of two referees and indicate whether we can contact them now.

You will also be required to upload a curriculum vitae, list of publications, a statement of research interests and a supporting statement. The supporting statement must explain how you meet each of the selection criteria for the post using examples of your skills and experience. This may include experience gained in employment, education, or during career breaks (such as time out to care for dependants).

Please upload all documents **as PDF files** with your name and the document type in the filename, quoting vacancy reference **161020**.

### **Applicants should ask their referees to send their letters of reference DIRECTLY to**

The Recruitment Coordinator (Vacancies)  
Mathematical Institute, Andrew Wiles Building, Radcliffe Observatory Quarter, Woodstock Road, Oxford, OX2 6GG. Tel: 01865 273525: Email: [vacancies@maths.ox.ac.uk](mailto:vacancies@maths.ox.ac.uk)

**by the closing date** (a letter by email is sufficient) **quoting the vacancy reference 161020**.

Referees should preferably not, all be from the same institution and whenever possible one should be the applicant's current, or most recent, supervisor. **NOTE: reference letters must be received from your referees by the closing date for your application to be complete.**

All applications must be received by **12.00 noon UK time on Wednesday 7<sup>th</sup> December 2022**.

Interviews are anticipated to take place in the week commencing **Monday 9<sup>th</sup> January 2022**.

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## Information for priority candidates

A priority candidate is a University employee who is seeking redeployment because they have been advised that they are at risk of redundancy, or on grounds of ill-health/disability. Priority candidates are issued with a redeployment letter by their employing department(s).

If you are a priority candidate, please ensure that you attach your redeployment letter to your application (or email it to the contact address on the advert if the application form used for the vacancy does not allow attachments).

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**DATA PROTECTION:** All data supplied by applicants will be used only for the purposes of determining their suitability for the post, and will be held in accordance with the principles of the Data Protection Act 1998 and the department's data protection policy.

<https://www.maths.ox.ac.uk/members/policies/data-protection/statement>

Due to the large volume of recruitment that the department administers we are unable to provide feedback to non-shortlisted applicants.

## If you need help

Help and support is available from: <https://hrsystems.admin.ox.ac.uk/recruitment-support>

If you require any further assistance please email [recruitment.support@admin.ox.ac.uk](mailto:recruitment.support@admin.ox.ac.uk).

To return to the online application at any stage, please go to: [www.recruit.ox.ac.uk](http://www.recruit.ox.ac.uk).

Please note that you will receive an automated email from our e-recruitment system to confirm receipt of your application. **Please check your spam/junk mail** if you do not receive this email.

## Important information for candidates

### Data Privacy

Please note that any personal data submitted to the University as part of the job application process will be processed in accordance with the GDPR and related UK data protection legislation. For further information, please see the University's Privacy Notice for Job Applicants at: <https://compliance.admin.ox.ac.uk/job-applicant-privacy-policy>. The University's Policy on Data Protection is available at: <https://compliance.admin.ox.ac.uk/data-protection-policy>.

### The University's policy on retirement

The University operates an Employer Justified Retirement Age (EJRA) for all academic posts and some academic-related posts. The University has adopted an EJRA of 30 September before the 69<sup>th</sup> birthday for all academic and academic-related staff in posts at **grade 8 and above**. The justification for this is explained at: <https://hr.admin.ox.ac.uk/the-ejra>

For **existing** employees, any employment beyond the retirement age is subject to approval through the procedures: <https://hr.admin.ox.ac.uk/the-ejra>

There is no normal or fixed age at which staff in posts at **grades 1–7** have to retire. Staff at these grades may elect to retire in accordance with the rules of the applicable pension scheme, as may be amended from time to time.

### Equality of opportunity

Entry into employment with the University and progression within employment will be determined only by personal merit and the application of criteria which are related to the duties of each particular post and the relevant salary structure. In all cases, ability to perform the job will be the primary consideration. No applicant or member of staff shall be discriminated against because of age, disability, gender reassignment, marriage or civil partnership, pregnancy or maternity, race, religion or belief, sex, or sexual orientation.

## Benefits of working at the University

### Employee benefits

University employees enjoy 38 days' paid holiday, generous pension schemes, travel discounts, and a variety of professional development opportunities. Our range of other employee benefits and discounts also includes free entry to the Botanic Gardens and University colleges, and discounts at University museums. See <https://hr.admin.ox.ac.uk/staff-benefits>

### University Club and sports facilities

Membership of the University Club is free for all University staff. The University Club offers social, sporting, and hospitality facilities. Staff can also use the University Sports Centre on Iffley Road at discounted rates, including a fitness centre, powerlifting room, and swimming pool. See [www.club.ox.ac.uk](http://www.club.ox.ac.uk) and <https://www.sport.ox.ac.uk/>.

### Information for staff new to Oxford

If you are relocating to Oxfordshire from overseas or elsewhere in the UK, the University's Welcome Service website includes practical information about settling in the area, including advice on relocation, accommodation, and local schools. See <https://welcome.ox.ac.uk/>. There is also a visa loan scheme to cover the costs of UK visa applications for staff and their dependents. See <https://staffimmigration.admin.ox.ac.uk/visa-loan-scheme>

### Family-friendly benefits

With one of the most generous family leave schemes in the Higher Education sector, and a range of flexible working options, Oxford aims to be a family-friendly employer. We also subscribe to My Family Care, a service that provides practical advice and support for employees who have caring responsibilities. The service offers a free telephone advice line, and the ability to book emergency back-up care for children, adult dependents and elderly relatives. See <https://hr.admin.ox.ac.uk/my-family-care>

The University has excellent childcare services, including five University nurseries as well as University-supported places at many other private nurseries.

For full details, including how to apply and the costs, see <https://childcare.admin.ox.ac.uk/>

### Disabled staff

We are committed to supporting members of staff with disabilities or long-term health conditions. For further details, including information about how to make contact, in confidence, with the University's Staff Disability Advisor, see <https://edu.admin.ox.ac.uk/disability-support>

### Staff networks

The University has a number of staff networks including the Oxford Research Staff Society, BME staff network, LGBT+ staff network and a disabled staff network. You can find more information at <https://edu.admin.ox.ac.uk/networks>

### The University of Oxford Newcomers' Club

The University of Oxford Newcomers' Club is an organisation run by volunteers that aims to assist the partners of new staff settle into Oxford, and provides them with an opportunity to meet people and make connections in the local area. See [www.newcomers.ox.ac.uk](http://www.newcomers.ox.ac.uk).